Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Re-Exam
June 2018

Max. Marks: **100** Duration: **3 hrs**
Class: **T. Y. B. Tech.** **Semester: VI** Program: **Mech Engg**
Name of the Course: **Internal Combustion Engines** Course Code: ~~MEC354~~ BTom 604

Instructions:

- **Question No. 1 is compulsory.**
- Attempt **any Four questions** out of remaining six questions.
- Answers to all sub questions should be grouped together.
- All questions carry equal marks.
- Make suitable assumptions with proper explanations.

Q. No.		Marks	CO No.	M. No.
Q. 1	**Answer the following questions (any Five)**	20	1 - 3	1-7
a)	Define the following terms related to reciprocating I.C. Engines : (i) Stroke (ii) Bore (iii) Top Dead Centre (TDC) (iv) Clearance Volume (v) Displacement Volume			
b)	Explain Scavenging of two stroke engines.			
c)	Explain why four stroke I C engine is always economical and less pollutant than two stroke IC engine.			
d)	Compare SI and CI engine with respect to : (a) Compression ratio (b) Speed (c) Efficiency (d) Weight			
e)	What is natural gas? What are the advantages and disadvantages of using compressed natural gas (CNG) as an alternate fuel?			
f)	How the lubrication of two-wheeler is done? What is the role of lubricating oil filter of automobile engines?			
Q. 2 (A)	A four-cylinder, four stroke SI engine, having a bore of 10 cm and stroke 9 cm runs at 4000 rpm. The fuel used has a carbon content of 84.50% and hydrogen content of 15.50% by weight. The volumetric efficiency of the engine at 75% of full throttle and at 4000 rpm is 0.85 referred to 300 K and 1 bar. The engine is to be supplied with a mixture of air coefficient 0.95 when running at 75% of full throttle. Calculate the throat diameter of the venture if the air velocity at throat is not to exceed 200 m/s under the above operating conditions. Also calculate the rate of fuel flow in kg/s at the pressure drop at venturi throat. Discharge coefficient for the venturi is 0.8 and the area ratio of the venture is 0.8. Take R for air as 0.287 kJ/kg K and for fuel vapour is 0.09 kJ/kg K.	10	3	2
(B)	**I)** What are the different types of ignition systems used in I.C. engines? What are their advantages? Explain any one system in detail.	05	2 & 3	3
	II) What are the basic requirements of an ideal ignition system?	05		3

Q. 3 (A)	How are solid injection systems classified? Explain the working of common rail individual pump and distributor systems with the help of neat sketches. Discuss their relative merits and demerits. What are the functional requirements of fuel injection systems in diesel engines?	**10**	3	3
(B)	A Morse test on 12 cylinders, two stroke C.I. Engine of bore 40 cm and stroke 50 cm running at 200 rpm.	**10**	3	4

The following results were obtained during test:

Condition	Break load(N)	Condition	Break load(N)
All firing	2040	7st cylinder	1835
1st cylinder	1830	8nd cylinder	1860
2nd cylinder	1850	9rd cylinder	1820
3rd cylinder	1850	10th cylinder	1840
4th cylinder	1830	11th cylinder	1850
5th cylinder	1840	12th cylinder	1830
6th cylinder	1855	All firing	2060

The output is obtained from dynamometer by using equation BP = WN/180, where W= Break load in Newton and N = speed in rpm.
Calculate IP, mechanical efficiency and BMEP.

Q. 4 (A)	The air flow to a 4 stroke, 4 cylinder Diesel Engine is measured by means of a circular orifice of diameter 50 mm. The coefficient of discharge of the orifice meter is 0.60. During a test on the engine the following data were recorded: The bore and stroke of the engine measures are 100 and 120 mm respectively. Speed = 1200 rpm, brake torque = 120 Nm, fuel consumption = 5 kg/hr and CV of fuel = 42 MJ/kg. Pressure drop across orifice is 4.6 cm of water. Ambient temperature and pressure are 17°C and 1 bar respectively. Determine: 1) Thermal efficiency on brake power basis, 2) BMEP, 3) Volumetric efficiency on the basis of air alone	**10**	2	4
(B)	What are the criteria for a good combustion chamber? Explain with a neat sketch the pre-combustion chamber used in C.I engines giving its salient features? Differentiate between open typed and close typed of combustion chambers. What are its relative merits and demerits?	**10**	3	3
Q. 5 (A)	**I)** What is the purpose of carrying out exhaust gas analysis?	**05**	1	5
	II) Write short notes on Properties of Lubricants.	**05**	1	6

(B)	A three-litre four stroke diesel engine develops 12 kW per m^3 of free air inducted per minute. The volumetric efficiency is 82% at 3600 rpm referred to atmospheric condition of 1 bar and 27°C. A rotary compressor which is mechanically coupled to the engine is used to supercharge the engine. The pressure ratio and the isentropic efficiency of the compressor are 1.6 and 75% respectively. Calculate the percentage increase in brake power due to supercharging. Assume mechanical efficiency of the engine to be 85% and air intake to the cylinder to be at the pressure equal to delivery pressure from compressor and temperature equal to 5.6°C less than delivery temperature of the compressor. Also assume that cylinder contains volume of charge equal to swept volume.	**10**	3	4
Q. 6 (A)	What are the differences in the knocking phenomena of the carbureted S.I. engine and C.I. Engine? What are the main functions of an injection pump? Draw a schematic diagram of fuel feed pump and explain its working principles.	**10**	3	3
(B)	The venturi of simple carburetor has a throat diameter of 20 mm and the co-efficient of air flow is 0.80. The fuel orifice has a diameter of 1.14 mm and the co-efficient of fuel flow is 0.65. The petrol surface is 5 mm below the throat. Find: (i) The air-fuel ratio for a pressure drop of 0.08 bar when the nozzle tip is neglected ; (ii) The air-fuel ratio when the nozzle tip is taken into account; (iii) The minimum velocity of air or critical velocity of air required to start the fuel flow when nozzle tip is provided. Take density of air and fuel as 1.20 and 750 kg/m^3 respectively.	**10**	2	4
Q. 7	**Write short note on following (any five)** **(A)** Effect of variable specific heat on efficiency of engine. **(B)** Phenomenon of dissociation **(C)** Five important efficiencies of IC engines **(D)** Desirable properties of good IC engine fuels **(E)** Importance of engine lubrication **(F)** Air cooling v/s Water Cooling	**20**	2	1-7

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End Semester Exam

May 2018

Max. Marks: **100** Duration: **3 hrs**

Class: **T. Y. Tech.** **Semester: VI** Program: **Mech Engg**

Name of the Course: **Internal Combustion Engines** Course Code: **ME 354**

Instructions:

- **Question No. 1 is compulsory**.
- Attempt **any Four questions** out of remaining six questions.
- Answers to all sub questions should be grouped together.
- All questions carry equal marks.
- Make suitable assumptions with proper explanations.

Q. No.		Marks	CO No.	M. No.
Q. 1	**Answer the following questions (any Five)**	**20**	1 - 3	1-7
a)	What are the advantages and disadvantages of two stroke engines over four stroke engines?			
b)	Explain firing order and how it is useful for design of ignition system?			
c)	Explain Phenomenon of dissociation.			
d)	What is accelerating system in a carburetor? Is it an essential system of desirable system? Explain with a neat sketch the working of accelerating system.			
e)	With a circuit diagram explain the working of battery ignition system.			
f)	Describe the phenomenon of knocking in S.I. engine and discuss various factors affecting knocking.			
Q. 2	Design a carburetor for 4 stroke 4 cylinder petrol engine. The specifications of engine and carburetor are as follows:	**10**	3	2
(A)	Engine capacity = 1500 CC, Max. Speed = 4200 rpm, volumetric efficiency = 70%, A/F ratio= 13:1, velocity of throat at peak power = 90 m/s, Coefficient of discharge for venturi and fuel jet = 0.85 and 0.7 respectively, diameter of emulsion tube = 1/ (2.5) of throat diameter, level of petrol surface below the choke = 6 mm, Specific gravity of fuel = 0.74, atmospheric pressure = 1.013 bar, atmospheric temperature = 20°C			
(B)	**I)** What are the different methods used in C.I. engines to create turbulence in the mixture? Explain its effect on power output and efficiency of the engine.	**05**	2 & 3	3
	II) What are the basic requirements of fuel injection system in C. I. Engine? Draw a neat sketch of Pintaux Nozzle and discuss its merits.	**05**		3
Q. 3	A 4 stroke C.I. engine develops a power of 25 kW per cylinder at 2500 rpm. The specific fuel consumption is 0.30 kg/kWhr for a fuel with 30°API. The fuel is	**10**	3	3
(A)	injected at a pressure of 150 bar over a crank travel of 25°. The pressure in the combustion chamber is 40 bar. Coefficient of velocity is 0.875 and specific gravity			

is given by

$$SG = \frac{141.5}{(131.5 + °API)}.$$

Calculate diameter of fuel injector orifice.

(B)	A 4-Cylinder, 4-stroke petrol engine develops a power of 21 kW. A Morse test was conducted at constant speed of 3000 rpm. BP is measured, when each cylinder was cut-off at 14.8, 14.5, 14.6, and 14.75 kW respectively. Find IP of the engine when all cylinders are developing power. Also find mechanical efficiency and BMEP. The cylinder bore and stroke are 75 mm and 90 mm respectively.	**05**	2	4
(C)	Define Octane and Cetane numbers. How will you improve the Octane rating of a fuel?	**05**	3	5
Q. 4 (A)	Willian's line test is conducted on a constant speed diesel engine operating at 1500 rpm and developing 50 kW BP at full load. Willian's line may be considered as a straight line upto 60% load, with the slope of the line being 8°. The fuel consumption for this engine is 2.46 kg/hr at 10 % load. Take CV of fuel = 42 MJ/kg. Calculate (1) FP, (2) fuel consumption in kg/hr at 60% load, (3) brake thermal efficiency at 60% load, (4) mechanical efficiency at 40% load, (5) Brake Torque at 40% load.	**10**	2	4
(B)	Describe the combustion Phenomenon in CI engines with help of p-θ diagram and explain each stages of combustion.	**10**	3	3
Q. 5 (A)	I) What are the sources of pollutants in I.C. engine? What measures can be taken to control the emissions from the engine?	**05**	1	5
	II) What are the different functions of lubricating systems? State the different lubricating systems used in I C Engines. Explain any one of them.	**05**	1	6
(B)	4-Stroke, 6-cylinder diesel engine of bore 8 cm and stroke 10 cm has rated speed 2500 RPM. It is to be operated at an altitude of 4000 m where ambient pressure and temperature are expected to be 0.7 bar and -5°C respectively. Estimate the probable loss of power as a percentage. If a supercharger of pressure ratio 2 is to be used as a corrective measure then determine the power required to operate the supercharger which has an isentropic efficiency of 75%. Assume the data, volumetric efficiency as 80% and Cp as 1 kJ/kgK. Ambient condition at sea level is 1 bar and 20°C. State any assumptions made.	**10**	3	4
Q. 6 (A)	A 4-cylinder, 4-stroke diesel engine develops a power of 180 kW at 1500 rpm. Its BSFC is 0.20 kg/kWh. At the beginning of injector pressure is 30 bar and the maximum cylinder pressure is 50 bar. The injection is expected to be at 200 bar and maximum pressure at the injector is set to be about 500 bar. Assuming the following: Coefficient of discharge for the injector = 0.7 Specific gravity of fuel = 0.875 Atmospheric pressure = 1 bar Effective pressure difference = Average pressure difference over the injection period	**10**	3	3

Determine the total orifice area required per injector if the takes place over 20° crank angles.

(B)	In a test of an diesel engine under full load condition the following results were obtained: IP = 33 kW, BP = 27 kW, Fuel used = 8 kg/h, Rate of flow of water through exhaust gas calorimeter = 12 kg/min, Cooling water flow rate to engine = 7 kg/min, Calorific value of fuel = 43 MJ/kg, Inlet temperature of cooling water = 15°C, Outlet temperature of cooling water = 75°C, Inlet temperature of water to exhaust gas calorimeter = 15°C, Outlet temperature of water to exhaust gas calorimeter = 55°C, Final temperature of the exhaust gases = 80°C, Room temperature = 17°C, A/F ratio on mass basis = 20, Mean specic heat of exhaust gas = 1 kJ/kgK, Specific heat of water = 4.18 kJ/kgK Draw up a heat balance sheet on kJ/min and percentage basis and estimate the indicated and brake thermal efficiencies and mechanical efficiency.	**10**	2	4
Q. 7	**Write short note on following (any five)** **(A)** Differentiate between Air-standard cycles and Fuel-air cycles **(B)** Main functions of an injection pump with schematic diagram **(C)** EURO norms and Rating of fuel **(D)** Wankel engine **(E)** SAE ratings of lubricants **(F)** Advantages and disadvantages of air cooling over water cooling	**20**	2	1-7

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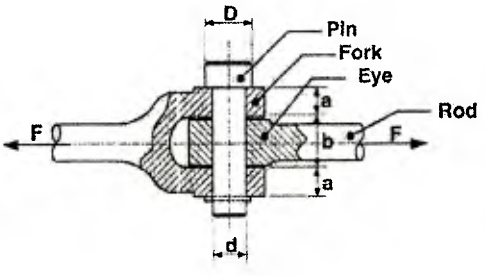
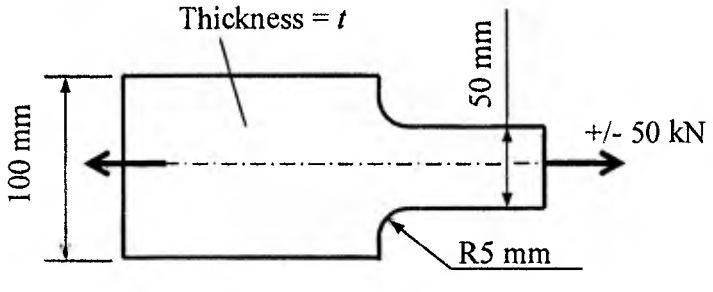
Re-Examination
June 2018

Program: **B.Tech. in Mechanical Engineering** Date: **June 2018**
Class: **T.Y. B.Tech. (Mechanical)** Duration: **3 Hr.**
Course code: **BTM602** Max. Points: **100**
Name of the Course: **Machine Design I** Semester: **VI**

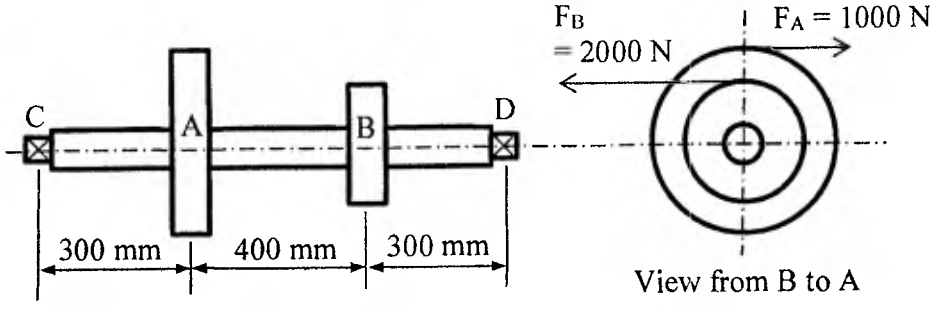
Instructions:

- Question No 1 is **compulsory**. Attempt any four questions out of remaining six.
- Use of PSG Design Data Book is allowed. Assume suitable data if necessary.

		Max. Points	CO No.	Module No.
Q1 A)	Explain the process involved in design of machine elements. Provide suitable example for illustration.	**(5)**	*4*	*1*
B)	Two rods are connected by knuckle joint. The axial load acting on rods is F = 30 kN. All parts are made of steel 45C8 (σ_{Yt} = 400 MPa, σ_{Yc} = 750 MPa, τ_Y = 200 MPa). The factor of safety on yield strength is 3 for pin and 4 for other parts. Given: d = 30 mm, a = 20 mm, b = 35 mm. Check the pin design for shear and compression failure. 	**(5)**	*1*	*2*
C)	Derive expressions for design of flat keys against shear and crushing modes of failure.	**(5)**	*2*	*4*
D)	Differentiate between flat and V-type belts in terms of their relative advantages and disadvantages.	**(5)**	*3*	*6*
Q2 A)	A component machined from a plate made of steel with ultimate tensile strength of 800 MPa is shown in the figure. It is subjected to a completely reversed axial force of 50 kN. For fatigue calculations, consider factor of safety as 2.0, notch sensitivity factor q = 0.8, size factor K_b = 0.85 and reliability factor K_c =0.9. Determine the plate thickness t for infinite life. 	**(10)**	*2*	*3*
B)	A direct reading spring balance consists of a helical tension spring, which is attached to a rigid support at one end and carries weights at the other free end. The pointer attached to the free end moves on a scale and indicates the weight. The	**(10)**	*2*	*5*

length of scale is 80 mm. The maximum capacity of the balance is to measure the weight of 600 N. The spring index is 6. The spring is made of oil hardened and tempered steel wire with ultimate tensile strength of 1500 N/mm^2. The permissible shear stress for spring can be taken as 50% of the ultimate tensile strength. Consider G = 82370 MPa. Design the spring and calculate: (i) wire diameter, (ii)mean coil diameter, (ii) mean coil diameter, (iii) number of active coils, (iv) required spring rate and actual spring rate.

Q3 A) Figure shows an intermediate shaft of a gearbox supporting keyed spur gears A and B and mounted between two bearings C and D. The pitch circle diameters of gears A and B are 400 mm and 200 mm respectively. The tangential forces acting on the gears are as shown. The shaft is subjected to heavy shock loads and is made of alloy steel 20Cr5Mo55 (S_{UTS} = 800 MPa, S_Y = 540 MPa). Recommend suitable diameter of the shaft using the ASME method. Ignore weight of gears and the radial force acting on gears. **(10)** *2* *4*



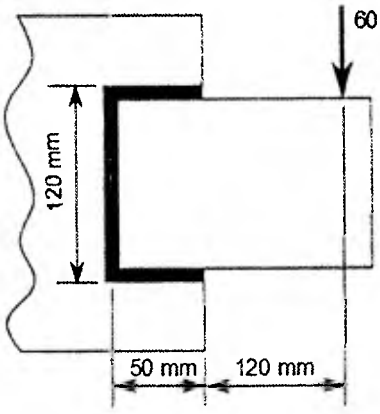
B) It is required to select a standard "HIGH-SPEED 878 g" belting to drive a stamp-press running at 700 rpm. The stamp-press is driven by 22 kW, 1400 rpm motor. Space available for centre distance is 3.6 meters. The belt is open type. Select suitable belt and determine its length. **(10)** *2* *6*

Q4 A) The stress analysis results for a critical machine component indicate following state of stress at a location: σ_x = 50 MPa, σ_y = 25 MPa and τ_{xy} = 25 MPa. Calculate factor of safety by maximum shear stress theory if yield strength of material is 400 MPa. **(5)** *1* *1*

B) Design screw and nut for a screw jack with load capacity of 30 kN and maximum lifting height of 500 mm. Do not design lifting collar/handle and support frame. Perform only single design iteration. Freehand draw assembly of the screw jack. **(15)** *4* *2*

Q5 A) What is nip of a leaf spring? Explain in brief. **(10)** *2* *5*
A semi-elliptic leaf spring used for automobile suspension consists of 4 extra full-length leaves and 14 graduated length leaves, including master leaf. The center to center distance between two eyes of spring is 1 m. The maximum force that can act on spring is 70 kN. For each leaf, ratio of width to thickness is 9:1. E = 207 GPa. The leaves are pre-stressed in such a way that when force is maximum, the stresses induced in all leaves is equal to 450 MPa. Determine (i) width and thickness of leaves, (ii) initial nip and (iii) initial pre-load required to close the nip.

B) A welded connection is subjected to eccentric load in the plane of welds as shown in the figure. Determine the size of weld. The permissible shear stress in welds is 60 MPa.

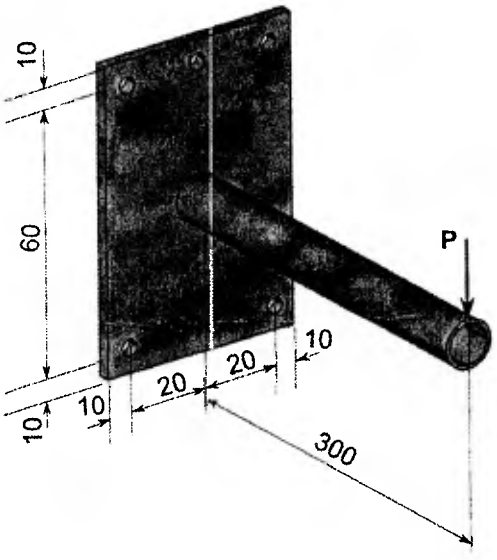


(10) *2* *7*

Q6 A) Describe the design considerations of components manufactured by casting process. Support your answer with suitable examples. **(5)** *3* *1*

B) A single strand chain drive is used to connect a 3 kW, 1100 rpm electric motor to a conveyor with speed reduction of 4:1. Select proper roller chain for the drive. Consider K_1 = multiple strand factor = 1.0. **(5)** *2* *6*

C) A support plate is attached to the wall by means of 5 identical bolts, 3 on the upper side and 2 on the lower side, as shown in the figure (all dimensions in mm). The load P acting on the pipe attached to the support plate is 600 N. Determine size of the bolt based on maximum principal stress theory. Permissible tensile stress in the bolts is 60 MPa. **(10)** *2* *7*



Q7 A) Explain the concept of preferred number series in context of machine design. It is required to standardize load-lifting capacities of cranes in the range of 50 kN to 600 kN. The company is interested in developing seven models in this range. Specify the lifting capacities. **(5)** *3* *1*

B) Select a standard bushed pin type flexible coupling to connect 30 mm diameter output shaft of an electric motor to the shaft of a compressor. The motor delivers 18 kW at 1500 rpm. The starting torque can be assumed to be 125% of rated torque. Check the acceptability of stresses in hub, pins and bushes of the selected coupling. Suggest modifications if necessary. **(10)** *2* *4*

C) Explain the significance of Soderberg and Goodman line in design of machine components subjected to fluctuating loads. **(5)** *1* *3*

Annexure: Additional Design Data

- Design factors for chain design

$K_s = service\ factor$

Type of driven load	*Type of input power*		
	I.C. Engine with Hydraulic drive	*Electric motor*	*I.C. Engine with Mechanical drive*
(i) *Smooth:* agitator-fan-light,conveyor	1.0	1.0	1.2
(ii) *Moderate shock:* machine tools-crane-heavy conveyor-food mixer-grinder	1.2	1.3	1.4
(iii) *Heavy shock:* punch press-hammer mill-reciprocating conveyor-rolling mill drive	1.4	1.4	1.7

$K_2 = tooth\ correction\ factor$

Number of teeth on the driving sprocket	K_2
15	0.85
16	0.92
17	1.00
18	1.05
19	1.11
20	1.18
21	1.26
22	1.29
23	1.35
24	1.41
25	1.46
30	1.73

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End Semester Exam

May 2018

Max. Marks: 100 | **Duration: 3Hours**

Class: T Y BTech | **Program: Mechanical Engineering**

Semester: VI | **Course Code : BTM651**

Name of the Course: Refrigeration and Air Conditioning

Instructions:

1) Question no.1 is compulsory and solve any four questions out of remaining six.
2) Use of refrigerant properties and psychrometric chart is permitted.
3) Use of steam table is permitted.
4) Assume suitable data and justify the same.

Question No		Maximum Marks	Course Outcome Number	Module No.
Q1		**20**		
(a)	Discuss the effect of evaporator pressure and condenser pressure on performance of vapour compression cycle.		1	01
(b)	Define Effective temperature. Enlist the factors governing effective temperature.		1	06
(c)	Explain Ozone Depletion Potential (ODP) and Global Warming Potential (GWP) of refrigerant.		3	03
(d)	Explain construction of psychrometric chart from various equations used for calculating properties of air by showing calculation of at least two properties for psychrometric chart.		1	04
Q2(a)	With neat T-s and p-h diagram explain actual vapour compression cycle.	**08**	1	01
(b)	A vapour compression refrigerator uses R-134a and works in the temperature range of -10°C evaporator temperature and 30°C condenser temperature. The single stage compressor has clearance ratio 0.03, swept volume 265 cm^3, and turns 2500 revolutions per minutes. The refrigerant at suction is dry saturated, the compression process is isentropic and expansion follows the law $pv^{1.12}$ = constant. Presuming that the refrigerant leaves the condenser with 5 degree subcooled, determine: (i) Mass flow of refrigerant (ii) Refrigeration capacity of plant (iii) Power input to compressor (iv) Coefficient of performance, and (v) Heat rejected in the condenser.	**12**	1,4	01

Q3(a)	Describe in detail desirable properties of refrigerants.	**08**	1,3	03
(b)	For a boot strap air refrigeration system for an aircraft flying at an altitude of 2000 m. The ram air temperature and pressure are 17°C and 1.08 bar respectively. The ambient conditions being 80 kPa and 0°C. At the end of isentropic compression the air is at 4 bar and is cooled to 27°C using ram air. At this temperature, air is further compressed in auxiliary compressor driven by cooling turbine; the air is then cooled in an auxiliary heat exchanger to 27°C and finally expanded to cabin pressure of 1.01325 bar. Find the maximum pressure in the system and COP, if air leaves the cabin at 25°C.	**12**	1,2	02
Q4(a)	Explain various methods of duct design.	**08**	1	05
(b)	Explain practical single effect water-lithium bromide absorption chiller with neat sketch.	**12**	2	07
Q5(a)	A mixture of dry air and water vapour is at a temperature of 21°C under a total pressure of 736 mm of Hg. The dew-point temperature is 15°C. Find (i) partial pressure of water vapour (ii) relative humidity (iii) specific humidity (iv) enthalpy of air per kg of dry air (v) specific volume of air per kg of dry air.	**10**	4	04
(b)	Draw a comfort chart and explain it in detail.	**10**	3	06
Q6	Given for a conditioned space: Room sensible heat gain = 20 kW Room latent heat gain = 5 kW Inside design conditions = 25°C DBT, 50% RH Bypass factor of the cooling coil = 0.1 The return air from the space is mixed with the outside air before entering the cooling coil in the ratio of 4:1 by weight. Determine: (i) Apparatus dew point (ii) Condition of air leaving cooling coil (iii) Dehumidified air quantity. (iv) Ventilation air mass and volume flow rates (v) Total refrigeration load on the air conditioning plant.	**20**	4	04
Q7(a)	Explain with neat sketch three fluid vapour absorption refrigeration system.	**10**	2	07
(b)	Discuss about various pressure losses occurring in air distribution system.	**10**	2	05

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Re Exam

June 2018

Max. Marks: 100
Class: T Y BTech
Semester: VI

Duration: 3Hours
Program: Mechanical Engineering
Course Code : BTM601

Name of the Course: Refrigeration and Air Conditioning

Instructions:

1) Question no.1 is compulsory and solve any four questions out of remaining six.
2) Use of refrigerant properties and psychrometric chart is permitted.
3) Use of steam table is permitted.
4) Assume suitable data and justify the same.
5) Answers to sub-questions should be grouped together.

Question No		Maximum Marks	Course Outcome Number	Module No.
Q.1				
(a)	Define 1 ton of refrigeration and show that it is equal to 3.51 kW.		1	I
(b)	In a vapour-absorption refrigeration system, the refrigeration temperature is -10°C. The generator is operated by solar heat where the temperature is reached 100°C. The temperature of heat sink is 45°C. What is the maximum possible COP of the system?	**20**	2	I
(c)	Compare primary refrigerants and secondary refrigerants.		1	VII
(d)	Define terms: (i) Humidity ratio (ii) Relative Humidity (iii) Degree of saturation (iv) Dew point temperature		3	VI
Q.2(a)	Explain effect of sub cooling and superheating in vapour compression system with T-s and P-h diagram.	**08**	1	I
(b)	An R-134a simple saturation cycle refrigerator operates at 40°C condenser and -16°C evaporator temperatures. Determine COP and HP/TR. If a liquid –vapour regenerative heat exchanger is installed in the system, with the suction vapour at 15°C, calculate the change in COP and HP/TR.	**12**	2	II
Q.3(a)	Explain boot strap system of aircraft refrigeration.	**08**	1	II
(b)	A regenerative aircraft refrigeration system is employed in an aircraft flying at a speed of 1500 km/hr. The ambient conditions are 0.1 bar and -63°C. The ideal pressure recovery factor is 0.92. The pressure ratio in main compressor is 5. The air bled off	**12**	1	I

	from the main compressor is first cooled in the air cooler with a cooling ratio of 0.6. In regenerative heat exchanger air is further cooled to a temperature of 30°C by chilled air from the exit. A temperature of this cooling air which is bypassed is 92°C. The remaining air from the cooling turbine exit goes to the cabin. The isentropic efficiency of compressor and turbine is 90% and 80% respectively. The cooling turbine drives the cooling air fan which draws in the cooling ram air discharge from the air cooler. The cabin is to be maintained at 1.01 bar and 27°C. Find (i) The mass of air bypassed for cooling purposes in regenerative heat exchanger in kg/min. Take tonnage capacity 30 TR. (ii) Mass of bleed off air in kg/min. (iii) COP of the unit excluding the power required in ram compression.			
Q.4(a)	Explain complete designation system of refrigerants.	**10**	3	III
(b)	Explain all desirable properties of refrigerants.	**10**	3	III
Q.5	A building has the following calculated cooling loads: Room sensible heat gain = 310 kW Room latent heat gain = 100 kW The space is maintained at DBT of 25°C and relative humidity of 50 %. The outdoor air is at 38°C and 50% R.H. And 10 % by mass of air supplied to the building is outdoor air. If the air supplied to the space is not at temperature lower than 18°C. Find (i) Minimum amount of air supplied to space in m^3/s. (ii) Volume flow rates of return air and outdoor air (iii) State and volume flow rate of air entering the cooling coil. (iv) Capacity, ADP, BPF and SHF of the cooling coil.	**20**	4	IV
Q.6(a)	A sample of moist air is at 30°C DBT and 20°C WBT. If barometer pressure is 740 mm of Hg. Calculate for sample of air without using psychrometric chart. (i) Relative humidity (ii) Humidity ratio (iii) Dew point temperature (iv) Density and (v) Enthalpy.	**10**	4	IV
(b)	Explain Electrolux refrigerator with neat sketch.	**10**	1	VII
Q.7(a)	Define the term "Effective Temperature" and explain its importance in air conditioning system. Describe factors which affect effective temperature.	**10**	1	VI
(b)	Explain various duct design methods.	**10**	1	V

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

May 2018

Total Marks : 100 Duration : 3 Hours

Class/Sem : T.Y B.Tech , Mech, Sem VI Subject : Lean and Green Manufacturing

Subject Code: 629

- Que.No 1 is compulsory
- Attempt any 4 questions out of remaining 6 questions.
- Answers to all sub questions must be grouped together.
- Figures to the right indicate full marks
- Assume suitable data wherever required.

QUE NO	QUE STATEMENT	MARKS	MODULE	CO
Q1	Prepare the roadmap for lean implementation in manufacturing industry. Explain it in detail.	20	M2	CO1, CO2
Q2	Prepare Ishikawa diagram showing classification of supply risks in JIT implementation and explain supply risk in detail	20	M7	CO4
Q3A	State the barriers for lean and relevant high performance manufacturing areas. Explain them in detail. Explain VSM in detail.	10	M1, M2	CO1, CO3
Q3B	Explore the relationship and prepare the table showing operational performance dimension, Internal performance measure, external performance measure and related lean barrier. Explain it in detail.	10	M1, M2	CO1, CO2
Q4A	State the significance of following Lean Green Practice bundles.1.Waste elimination practice bundle 2.Green quality practice bundle 3.Low cost practice bundle	10	M3	CO4
Q4B	State the significance of following Lean Green Practice bundles 1.Green human resource management practice bundle 2.Health and safety practice bundle 3. Creativity and innovation practice bundle	10	M3	CO4
Q5A	Prepare the model consisting Lean HR barriers, drivers, enablers , managerial implications for successful lean implantation. Explain the model in detail.	10	M5	CO1, CO2
Q5B	Prepare the table showing Strategies, guidelines and action plan for major HR barriers for lean implementation. Explain them.	10	M5	CO1, CO4
Q6A	Prepare and Explain the Manufacturing Throughput Time per Part (MTTP) Reduction Framework	10	M3	CO4
Q6B	State and explain the expected Performance Outcomes by Implementing Green manufacturing	10	M7	CO4
Q7A	State and explain Green Practices towards Sustainability	10	M6, M4	CO4
Q7B	Explore the Major Losses in industry creating impact on Overall Equipment Effectiveness (OEE)	10	M3	CO1, CO4

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BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination

May 2018

Maximum Points: 100 **Duration: 3 Hrs**

Class: **T.Y. B. Tech. (Mechanical)** Semester: **VI**

Program: **B. Tech. (Mechanical Engineering)**

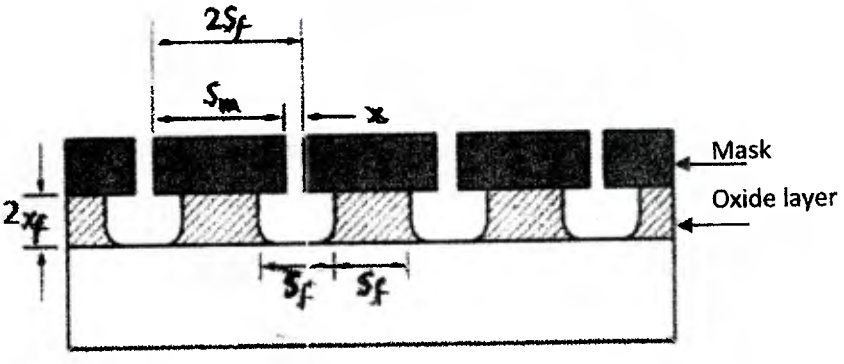
Name of the Course: **Introduction to Micro Electro Mechanical Systems**

Course Code: **BTM625**

Instructions:

1. **Question number 1 is compulsory; attempt any four questions from remaining questions.**
2. **Draw neat diagrams wherever necessary.**
3. **Assume suitable data if necessary.**

Q. No.		Max. Points	CO No.	M. No.
1. (a)	Following are the system and material property data employed for part fabrication in an scanning type microstereolithography system. Resin: Trimethylolpropane Triacylate (TMTPA), having critical energy 60 mJ/cm^2, penetration depth = 90 microns when exposed to UV light. Laser beam power=150 microwatt, Scan speed=0.7 mm/s, Gaussian half widh=6 microns, For Gaussian beam laser estimate the maximum layer thickness that can be used in layer-by-layer fabrication. Also estimate the maximum intensity at the exposure resin surface and at a distance 80 microns below free resin surface.	10	4	4
(b)	Explain Chemical Vapour Deposition (CVD) process with neat labelled sketches	10	2	3
2. (a)	Explain LIGA with neat labeled diagram	10	2	4
(b)	What is Physical Vapor deposition (PVD) process? Explain with neat labeled diagram	10	2	3
3. (a)	Explain Bulk lithography with neat labeled diagram. What are the advantages of Bulk lithography over microstereolitography? Also discuss limitations of the process.	10	3	4
(b)	Explain projection type microstereolithography process for 3D fabrication with neat labelled sketches. What are the advantages and disadvantages of projection microstereolithography against scanning type microsetereolithography?	10	3	4
4 (a)	Describe the four popular actuation techniques for micro devices. Provide at least one major advantage and one disadvantage of each of these techniques.	10	1	2
(b)	With neat diagram explain design consideration in MEMS	10	4	5
5 (a)	Explain scanning electron microscope (SEM) with neat sketch. What is the difference between Field Emission Gun (FEG) and environmental SEM?	10	3	6

(b)	Explain Lithography with neat labelled sketches	**10**	**3**	**4**
6 (a)	Explain Laser Doppler Vibrometer (LDV) and atomic force microscopy (AFM) with neat labeled diagrams	**10**	**3**	**6**
(b)	Explain Reactive Ion Etching (RIE) with neat labeled diagram. Also state advantages and disadvantages of Reactive Ion Etching	**10**	**2**	**3**
7(a)	Following figure shows mask and oxide layer in process of chemical etching. The oxide layer is 0.5 μm. Equal structure widths and spacings, S_f, are desired. The etch anisotropy is 0.8. If the distance between the mask edges, x, is 0.35 μm, what structure spacings and widths are obtained? 	**10**	**4**	**3**
(b)	Write short note on Carbon Nanotube and its applications	**10**	**1**	**7**

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Sardar Patel College of Engineering

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Munshi Nagar, Andheri (West), Mumbai – 400058

END SEMESTER EXAMINATION
May 2018

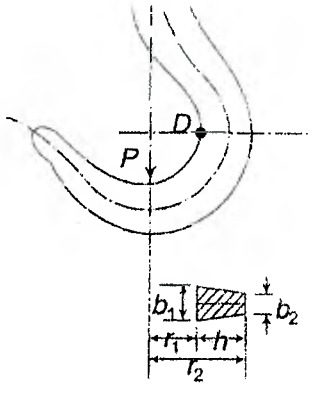
Program: **B.Tech. in Mechanical Engineering**
Class: **T.Y.B.Tech. (Mechanical)**
Course code: **BTM626**
Name of the Course: **Advanced Solid Mechanics**

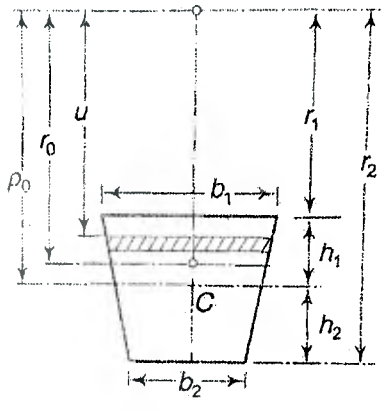
Date: **May 2018**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VI**

Instructions:

- **Question no. 1 is compulsory**. Solve any four out of remaining six questions.
- Assume suitable data if necessary.

		Max. Points	CO No.	Mod No.
Q1 A)	Explain the construction Mohr circle for 3D state of stress with neat sketch indicating position of critical stress locations.	**(4)**	*2*	*2*
B)	Prove that for thin walled box sections $T = 2qA$ where T is torque applied, q is shear flow and A is area enclosed by the thin section.	**(4)**	*3*	*3*
C)	Give expressions for bending stress induced in straight and curved beams subjected to bending moment M and explain the terms involved. Compare with neat sketch the distribution of bending stress across thickness for straight and curved beams.	**(4)**	*4*	*4*
D)	Explain the limitation of Euler's buckling formula and describe how it is addressed in Rankine buckling formula.	**(4)**	*4*	*5*
E)	The governing partial differential equation for thin flat rectangular plates subjected to transverse loading is given by $\frac{\partial^4 w}{\partial x^4} + 2\frac{\partial^4 w}{\partial x^2 \partial y^2} + \frac{\partial^4 w}{\partial y^4} = \frac{p(x,y)}{D}$. With the help of neat sketch, explain the terms involved in the equation. What are the major assumptions made during derivation of the equation?	**(4)**	*3*	*6*
Q2 A)	Determine the stress at point D of hook shown in the figure having trapezoidal section with following dimensions (in mm): $r_1 = 35$, $r_2 = 100$, $b_1 = 50$, $b_2 = 25$, The hook is subjected to load P = 40 kN.	**(10)**	*4*	*4*





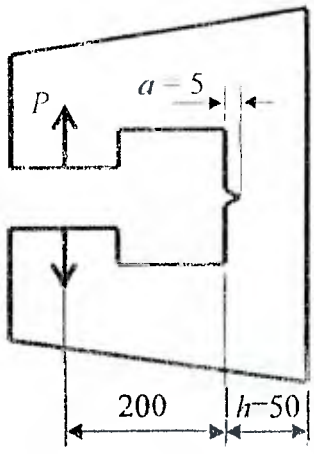
For trapezoid section:

$$r_0 = \left[\frac{(b_1+b_2)h}{2}\right] \Big/ \left\{[b_2 + r_2(b_1 - b_2)/h]\log_e \frac{r_2}{r_1} - (b_1 - b_2)\right\}$$

$$\rho_0 = r_1 + \frac{(b_1+2b_2)h}{3(b_1+b_2)}$$

B) At a point P in a body, $\sigma_x = 2\ MPa,\ \sigma_y = -1\ MPa,\ \sigma_z = 3\ MPa,\ \tau_{xy} = \tau_{yz} = \tau_{zx} = 3\ MPa$. Determine magnitude and direction of normal and shear stresses on a plane that is equally inclined to all the three axes. **(10)** *1* *1*

Q3 A) Figure shows a 30 mm thick metal plate frame for a clamping device (all dimensions in mm). Find safe load P in the presence of a crack in the frame at location shown. Material data: $K_{Ic} = 60$ MPa$\sqrt{m}$, $\sigma_Y = 1200$ MPa. **(10)** *2* *2*



B) Compute critical buckling load and mode shape for a 20 mm round bar of steel of 1200 mm length for following end conditions: **(10)** *4* *5*
(i) Both ends pinned
(ii) One end pinned and other fixed
(iii) One end pinned and other free
Consider E = 200 GPa.

Q4 A) A hollow aluminium section is designed as shown in Fig.(a) for a maximum shear stress of 40 MPa, neglecting stress concentrations. Find the twisting moment that can be taken up by the section and the angle of twist if the length of member is 2000 mm. If the member is redeisigned as shown in Fig.(b), find allowable twisting moment and angle of twist. Take G = 25 GPa. **(10)** *3* *3*

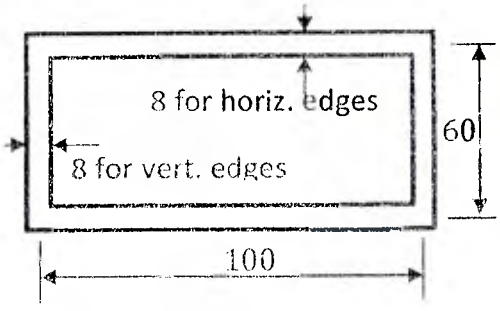


Fig. (a)

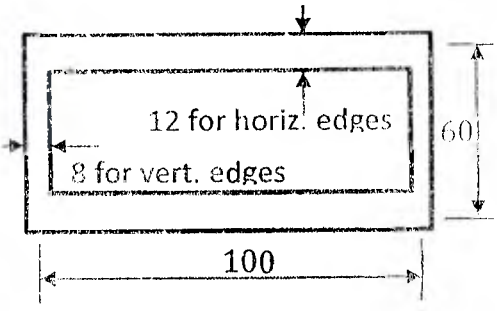


Fig. (b)

(All dimensions in mm)

B) Determine the maximum bending stress and deflection for an annular plate of 800 mm outside diameter, 500 mm inside diameter, 8 mm thick, subjected to pressure of 0.05 MPa for following two cases: (i) Outer edge simply supported and inner edge free, (ii) Outer edge simply supported and inner edge guided. E = 200 GPa, $\nu = 0.3$. **(10)** *3* *6*

Q5 A) The state of stress τ_{ij} at a point is as shown. Calculate the principal stresses and find the principal direction associated with the maximum and minimum principal stress. **(10)** *2* *1*

$$\tau_{ij} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -3 & 4 \\ 3 & 4 & 5 \end{bmatrix}$$

B) Calculate circumferential discontinuity stresses at hemispherical head to cylindrical shell junction for a pressure vessel subjected to internal pressure of 3 MPa. Freehand plot the circumferential stresses in shell starting from the junction and at three intermediate points away from the junction over a total distance of attenuation length. The radius of shell is 1500 mm and thicknesses of both shell and head is 30 mm. Consider Poisson's ratio = 0.3. **(10)** *3* *7*

Bharatiya Vidya Bhavan's

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End Semester Exam
May 2018

Program: **B.Tech. in Mechanical Engineering**
Class: **Third Year B.Tech. (Mechanical)**
Course code: **BTM603**
Name of the Course: **Health Safety and Environment**

Date: **18 May 18**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VI**

Instructions:

- Attempt any five out of seven questions.

		Max. Points	CO No.	Module No.
Q1	A) Discuss the various theories of accidents.	(5)	1	1
	B) If an engineer wishes to get himself/herself certified in a safety program, discuss the certification that you would recommend.	(5)	1	1
	C) Discuss types of safety aids with respect to machine safeguarding.	(5)	1	3
	D) Discuss types of machine guards. Which machine guard is best and why?	(5)	1	3
Q2	A) Discuss the various rights given by the OSH Act to employees.	(5)	2	2
	B) Discuss objectives of workers' compensation.	(5)		
	C) Discuss how the following can prevent liability (i) User feedback (ii) Product literature (show illustrations)	(5)		
	D) Discuss the reasons for conducting an accident investigation.	(5)		
Q3	A) Discuss five engineering controls at the source with suitable examples.	(5)	1	3
	B) Discuss how Ford implemented ISO 14001 in their TCAP plant. What benefits were derived?	(5)		
	C) Build an ethics philosophy for your company by listing ten points.	(5)		
	D) Discuss how to mitigate hazards related to IC engines and spray painting booths	(5)		
Q4	A) Examine how Solapur and Panchgani are implementing solid waste management.	(5)	2	4
	B) Discuss causes of air pollution. Also analyze the effects of air pollution on the human body.	(5)		
	C) Discuss control strategies for combatting major sources of air pollution.	(5)		
	D) Discuss two most efficient devices for capturing pollutants.	(5)		
Q5	A) Discuss why the Environmental Protection Act was implemented, its coverage, and purpose.	(5)	3	5
	B) Discuss some of the salient features of the Air Act. Discuss why the closure of Continental Carbon India Ltd. took place?	(5)		
	C) Discuss the objectives and origins of the Water Act? Mention its drawbacks.	(5)		
	D) Discuss the salient features of the Biodiversity Act.	(5)		
Q6	A) Discuss the problem in Tigray region and solution adopted by them.	(5)	3	6
	B) Discuss how UNCCD operates? Analyze role of India as part of UNCCD.	(5)		

09/10.

	C) Discuss the Paris Agreement on climate change. D) Discuss how RAMSAR convention works	(5) (5)		
Q7	A) Discuss the GRIHA approach B) Examine how government buildings in future will be developed in India C) Discuss how Engineers India Limited have benefited from GRIHA with respect to site, water and building materials. D) Discuss the benefits of GRIHA	(5) (5) (5) (5)	*4*	*7*
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